

Executive summary

This inquiry has unfolded against a background of power shortages and black-outs, extreme weather events such as record heat waves and storms, and ongoing climate change denialism within the ranks of the Coalition government that has caused an abject failure on climate and energy policy at the national level.

A key contributor to the current situation was the decision by the Coalition to divorce energy policy from climate policy and remove a carbon price signal. Let us be clear: there never was any real-world rationale for the abolition of a carbon price. Instead, it was done for ideological reasons and base political gain. The schism wrought in Australian politics over climate and energy policy by the Coalition has been disastrous for political discourse in this country and is now having severe adverse economic, social and environmental consequences for the nation.

Australia's existing electricity network was built to support the outdated and dirty coal-fired power stations. The world is moving rapidly to decarbonise electricity supply and the current owners of coal-fired power stations were quite emphatic in telling this committee (and the concurrent Senate Environment and Communications References Committee inquiry into the retirement of coal-fired power stations) that they are getting out of coal and have no intention of building any more coal-fired power stations. By definition, therefore, coal has no role to play in a secure energy future. Coal-fired power stations are being closed down and coal is in structural decline.

The market has moved. Investors have now priced climate risk into their calculations about the sources of future electricity generation. Investors know that a price on carbon is inevitable, but the debacle around climate and energy policy has left investors guessing about the timing and size of the price on carbon. In sum, the Coalition government's lack of any coherent policy on climate change and energy has led to an investment strike in sections of the energy sector that has imperilled the security and resilience of Australia's electricity infrastructure. The committee does recognise however that, while there is an investment strike in parts of the fossil fuel based energy generation market, multiple significant projects are being privately funded currently in the renewable energy sector. It is a testament to the economic viability of renewable energy projects that that investment is taking place, despite the outdated regulatory structure of the National Energy Market (NEM) and the ongoing carbon policy uncertainty at a Federal level.

Both the Australian Greens and the Australian Labor Party have long advocated the need for a clear, consistent, long-term price signal for carbon emissions. Coal has never had to pay for the enormous burden it has imposed on society for its role in causing climate change. The introduction of a market-based carbon trading scheme would effectively end the decades-long implicit subsidy that coal has received in the electricity generation market. Yet, like the proverbial ostrich, the Coalition government has buried its collective head in the coalmine and refuses to address in any meaningful way the crisis facing the nation. It used to be said that the Coalition was on the wrong side of history when it came to climate change and energy policy.

Yet it is now abundantly clear that the Coalition is also on the wrong side of the market.

Australia needs to move urgently to renewable sources of energy for electricity production in order to meet its international obligations for reducing emissions. Instead of gloating about its destruction of an effective carbon pricing mechanism, and propagandising on the floor of Parliament about a redundant technology (coal), the Coalition government has a responsibility to build a national consensus on carbon pricing. A range of stakeholders including BHP Billiton, Energy Networks Australia, Energy Australia, AGL Energy Ltd, Origin Energy, the Business Council of Australia and the National Farmers' Federation have demanded that the government put in place a price on carbon emissions. Yet the Coalition government has pre-emptively ruled out carbon pricing in an attempt to appease the climate deniers that have shackled government policy on this matter.

The terms of reference for this inquiry do not refer to the contribution of gas-fired power stations in improving the resilience of Australia's electricity infrastructure. Nevertheless, as part of the wider economic context, it is germane to touch on the potential role of natural gas in Australia's electricity production. Natural gas was once touted as the fuel that would ease the transition from Australia's heavy reliance on coal-fired electricity to an electricity grid powered by renewable energy sources.

However, the evidence received during this inquiry indicates that there are serious questions about whether gas can adequately fill this transitional role. Australia has a plentiful supply of natural gas. Yet the bulk of Australia's natural gas is liquefied and shipped offshore, primarily to fill long term export contracts to Japan, Korea and China. The export of the vast majority of Australia's natural gas has occurred because of the relatively high prices that were achieved overseas when long-term supply contracts were first signed. Even though the international gas price has now fallen substantially, the evidence suggests that the amount of Australia's gas being exported will increase even further in the future in order to fulfil existing long-term supply contracts overseas.

The entry of the east coast of Australia into the global gas market through the construction of the liquefaction plants near Gladstone in Queensland has had a dramatic impact on the domestic gas market. The domestic gas market is now in severe shortage, and this appears unlikely to change as increasing gas exports suck ever more gas away from the domestic market. It is therefore hardly surprising that domestic gas prices on the east coast of Australia have soared.

It has been suggested that the shortage of gas on the east coast could be alleviated by opening up more farmland to relatively high-cost unconventional gas mining such as coal seam gas. Quite apart from the irreparable damage that would be done to valuable farmland, the fugitive emissions from unconventional gas mining indicate that the greenhouse gas emissions from using this source of gas as a power generation source are every bit as bad as using coal. Furthermore, the misplaced notion that coal seam gas could provide a solution to the gas shortage on Australia's east coast displays a profound ignorance of how the market works. Any unconventional gas will surely find its way onto the export market if, as key witnesses indicated, the export market for gas is under-supplied in the future.

A gas reservation policy has also been touted as a potential solution to the east coast gas shortage. However, there is no guarantee that a gas reservation policy will reduce gas prices on the domestic market. Furthermore, there is a risk that a gas reservation policy would deter the necessary investment in, and deployment of, renewable energy.

Much has been made of the problems that intermittent renewable energy generation poses for the reliability of the electricity grid. The factors outlined above regarding the use of gas as a back-up source of power generation highlight the urgency of ensuring the security of Australia's electricity networks through a combination of storage technologies and decentralised electricity generation.

Fortunately, the committee received abundant evidence that a diverse range of complimentary storage technologies—including off-river pumped hydro, thermal energy storage, and batteries—are able to overcome the problems of intermittent generation and allow the grid to be converted to 100 per cent clean renewable energy at minimum cost.

Off-river pumped hydro can be developed on a small scale with minimal negative environmental impacts (in contrast to traditional large-river hydroelectric dams). Pumped hydro is a widely-used and well-developed technology with a strong track record. One utility-scale off-river pumped hydro project is being developed in Australia in a disused mine site in Northern Queensland, while a feasibility study in the Spencer Gulf in South Australia is examining a coastal pumped hydro system which would only require a single reservoir and has the potential to be co-located near wind and solar electricity generators.

The Australian National University is also conducting a study to identify suitable sites for off-river energy storage. Its initial report found a wealth of potential sites across the country. The committee is of the view that this study should be fast-tracked and that the Commonwealth government should commission a full scoping study to evaluate as a matter of priority issues such as the selection, planning and environmental assessments for the most appropriate off-river sites.

The committee also heard about two thermal energy storage technologies. The first, molten salt with solar thermal power is in operation overseas and is currently being proposed for a site in South Australia. The second, molten silicon, was initially developed by the Commonwealth Scientific and Industrial Research Organisation (CSIRO), and appears capable of being used 'behind the meter' and at intermediate scales.

In addition, both off-river pumped hydro and thermal energy storage offer a range of ancillary benefits that are critical for the security of grid networks, and these are discussed later.

The committee received evidence that perhaps the quickest solution to the immediate requirements of the national grid is the immediate roll-out on a massive scale of decentralised battery storage and smart technologies on various scales. Several battery technology proponents based in Australia have been working on storage solutions for several years and have identified locations where the technology can be deployed now.

Battery storage solutions have particular benefits:

- Firstly, if these projects are begun now, they could be in place ahead of the anticipated energy shortfalls next summer. Let there be no doubt about the speed with which this could occur: a newly-announced 330 megawatt solar farm with 100 megawatt battery storage located in South Australia is expected to be completed by the end of 2017.
- Secondly, the ability of people to produce, consume, store, aggregate and trade electricity allows for the democratisation and decentralisation of grid networks and the reduction of energy bills for households. It effectively puts power back in the hands of the people. Decentralisation of generation increases the resilience of the network as localised events have a limited impact. An added benefit of this transformation will be the reduction of rent-seeking behaviour by the major centralised players in the current electricity system who have profited at community expense by commodifying what is an essential service and what used to be considered a public good.

However, the committee emphasises that it is not endorsing one type of storage technology over another. On the contrary, the committee is of the view that a diversity of storage technologies in geographically diverse locations and at a diversity of scales is most likely to offer a complimentary array of services to households, businesses and industry and to contribute favourably to the resilience of grid networks.

Furthermore, the evidence is clear that only a diverse mix of storage technologies will provide grid networks with the full range of essential ancillary services—such as very fast primary frequency response, system inertia, spinning reserve and synchronous capacity for frequency and voltage support, energy balancing, and black-start capability—that are essential for the security of the electricity system.

The committee also received a wealth of evidence that Australia is well-endowed with renewable energy resources and that the renewable energy and energy storage transformation will create significant economic opportunities including a wave of new jobs that, if done in a well-planned way, will help secure a just transition for workers previously employed in the old energy systems.

The committee notes and commends recent initiatives of state governments, in particular the South Australian and Victorian governments, to support battery storage.

However, there are significant barriers to the introduction of energy storage technologies. The committee heard evidence that the rules that govern the NEM are arcane and no longer fit for purpose. The current rules favour the large fossil fuel generators who are able to game that system at community expense. At the same time, the rules systematically discriminate against storage systems. Yet modern electricity networks need far greater flexibility to respond rapidly to fluctuations in supply and demand. Storage systems such as batteries and pumped hydro can respond rapidly and are critical to balancing an electricity network.

The bidding and settlement systems under the NEM are out of alignment. Bids are accepted on five minute intervals, whereas payments are averaged over a 30 minute period. This means that storage systems such as batteries which are able to respond in seconds and milliseconds to sudden fluctuations in the system are unable to capture

the full value of the services that they offer because those high-value services may only be needed for a one minute, five minute or ten minute interval, and yet the price received could be averaged down over a half hour period. All the evidence available to the committee made it clear that the 30 minute settlement period for prices needs to be urgently changed to a five minute settlement period in order to encourage the necessary investment in storage that will provide electricity networks with the resilience and flexibility to respond to current and future challenges.

Evidence provided to the committee concerning the delay in the implementation of the five minute rule and the capacity for other rules to produce perverse and unintended outcomes demonstrate a deeper problem: the reluctance of the rule maker to embrace any change in a timely manner. The Australian Energy Market Commission (AEMC) is in need of fundamental reform. It is clearly both captive to the incumbent industry and hostile to the inevitable transition away from the current status quo. If the AEMC is unable to adequately address these concerns in a reasonable timeframe, it should be abolished and replaced with a more responsive and accountable regulatory body that is actually fit for purpose.

In summary, two key policy changes need to be made to ensure the market functions in the national interest. First, it is vital that a market signal is put in place to price carbon. This will provide business with increased certainty, allowing them to invest even more confidently in the clean renewable energy generation technologies required to reduce emissions and ensure a clean grid. Secondly, the payment settlement rules that operate in the NEM need to be changed to five minute intervals in order to encourage the rapid uptake of energy storage solutions.

Despite the enormous opportunities from energy storage and the rhetorical flourishes from the Prime Minister regarding storage, the Commonwealth government has failed to put in place policies that support businesses, households and grid level storage.

A feasibility study into Snowy Hydro pumped hydro is no substitute for comprehensive national policies and regulatory changes that will drive change across the whole grid and system.

The committee also found that these challenges to the electricity system will be exacerbated as climate change loads the dice in favour of more severe and, in some cases, more frequent extreme weather events.

The recent South Australian blackout caused by extreme weather toppling power pylons, the recent impact of heatwaves on fossil fuel generation in New South Wales (NSW) and the impact of Cyclone Debbie and subsequent floods in Queensland and NSW on electricity distribution highlight the effect extreme weather events can have on our electricity system.

Fortunately the solutions to the problem of transitioning our electricity grid to cleaner energy will also make our grid more resilient and better able to cope with the challenges of climate change as our energy generation becomes more diverse and storage proliferates through households, businesses and the grid.

In summary, the committee is strongly of the view that a diversity of storage technologies including batteries, thermal energy storage, and off-river pumped hydro, combined with decentralised generation and storage, will address the issues of

intermittency associated with wind and solar PV electricity generation, will help balance the grid, will ensure that grid networks are provided with the full range of necessary ancillary services, and will therefore significantly improve the resilience of Australia's electricity infrastructure in a warming world.